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Tracing the origin and mobilization of Glyphosate and AMPA in a vineyard catchment

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Pesticides residues are often found in storm-water runoff in agricultural areas. There are several pathways along which pesticides may be transported from their application point towards the river. Although the primary target of pesticide application is the agricultural area, wind drift transports pesticide droplets to non-target areas. Furthermore, miss-operation of application machines results in the deposition of pesticides at filter strips or roads from where they can be washed off. Therefore, it may be difficult to identify the origin of pesticides in storm-water runoff. However, management of water quality requires that critical source areas are clearly delineated in order to effectively reduce water pollution.

In the Rouffach catchment, a 42.7 ha vineyard catchment in France, Glyphosate and its transformation product AMPA occurred frequently and in high concentrations in runoff water during rainfall-runoff events in 2008. In order to identify the source areas of Glyphosate residue pollution and its mobilization, we used here a combination of sampling data analysis techniques and distributed pollutant transfer modelling. Available sampling data allowed for an analysis by Normalized Cumulative Loads (NCL) at a high temporal resolution (10 min). The results imply that pollutant mobilization took place mainly at the beginning of an event. This First Flush suggests a wash off of substances from impervious surfaces such as roads. This assumption was confirmed by local hydrological knowledge about infiltration rates in the vineyard, which were not exceeded by rainfall intensities in most considered events. Additionally, the distributed process-based reactive transport model ZIN-AgriTra was used as a learning tool to evaluate the pesticide mobilization and export processes. The hydrological model was successfully calibrated and validated for long high-resolution time series of discharge data. Pesticide export modelling focused on the first rainfall-runoff event following the first significant Glyphosate application in 2008. Assuming only target Glyphosate application, hardly any export of Ghyphosate and AMPA occurred. Therefore, non-target application at adjacent roads was introduced into the model. By assuming different mobilization processes of substances on the roads, our results show that storage of sorbed pesticides (e.g. road sides, unpaved roads) and storage without sorption (e.g. plant surface, paved roads) significantly contributed to the total pesticide residue export.

Concluding, it is likely that the major part of pesticides in runoff of the Rouffach catchment originates from the roads rather than from the vine growing areas and that the mobilization process is a combination of both sorptive and non-sorptive substance storage. Thus, avoiding non-target pesticide application could largely help to mitigate water contamination in this catchment.